StarTran System Architecture

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What is an Architecture

- Like architectural drawings for a building:
  - A preliminary plan for what the building might be
  - Multiple views from different angles to give a feel for what it might look like
  - Plot plans to show how it with fit on the land
  - Floor plans to show work flow and how thing fits
- A system architecture is a high level design with multiple views.
- The Architecture may show more than you will initially build.

Why Do You Need To Review?

- Make sure we are heading down the right track.

- Understand the background for some of the decisions you will need to make.

If you can't read the whole document, at least read and comment on the sections that impact you.

What Are System Architecture Views?

- Architectural views are a way of organizing a conceptual design.
- Each view represents a different stakeholder in the design process
- Together, the views represent a roadmap for more detailed requirements defined and more detailed design.
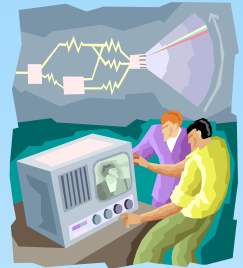
Operations View

- Shows how the system . . .
  - Will be operated
  - The impact on StarTran operations
  - The impact on the public
- Little has changed from the Concept of Operations.
- Included for completeness of viewpoints.
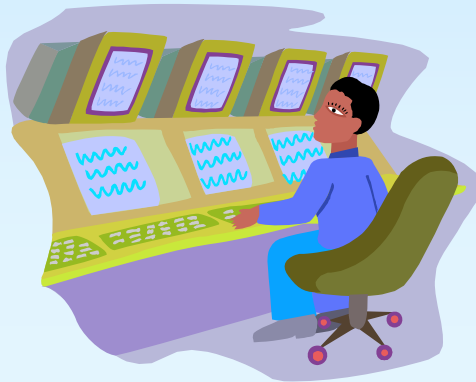
Information View

- This view typically helps define information sources, dependencies, and flows.

- We use it to plan the design for database, reports, and communications.

- It identifies the need for data transfer capabilities and how much data will need to be transferred.

- When you review… are there key pieces of information missing?
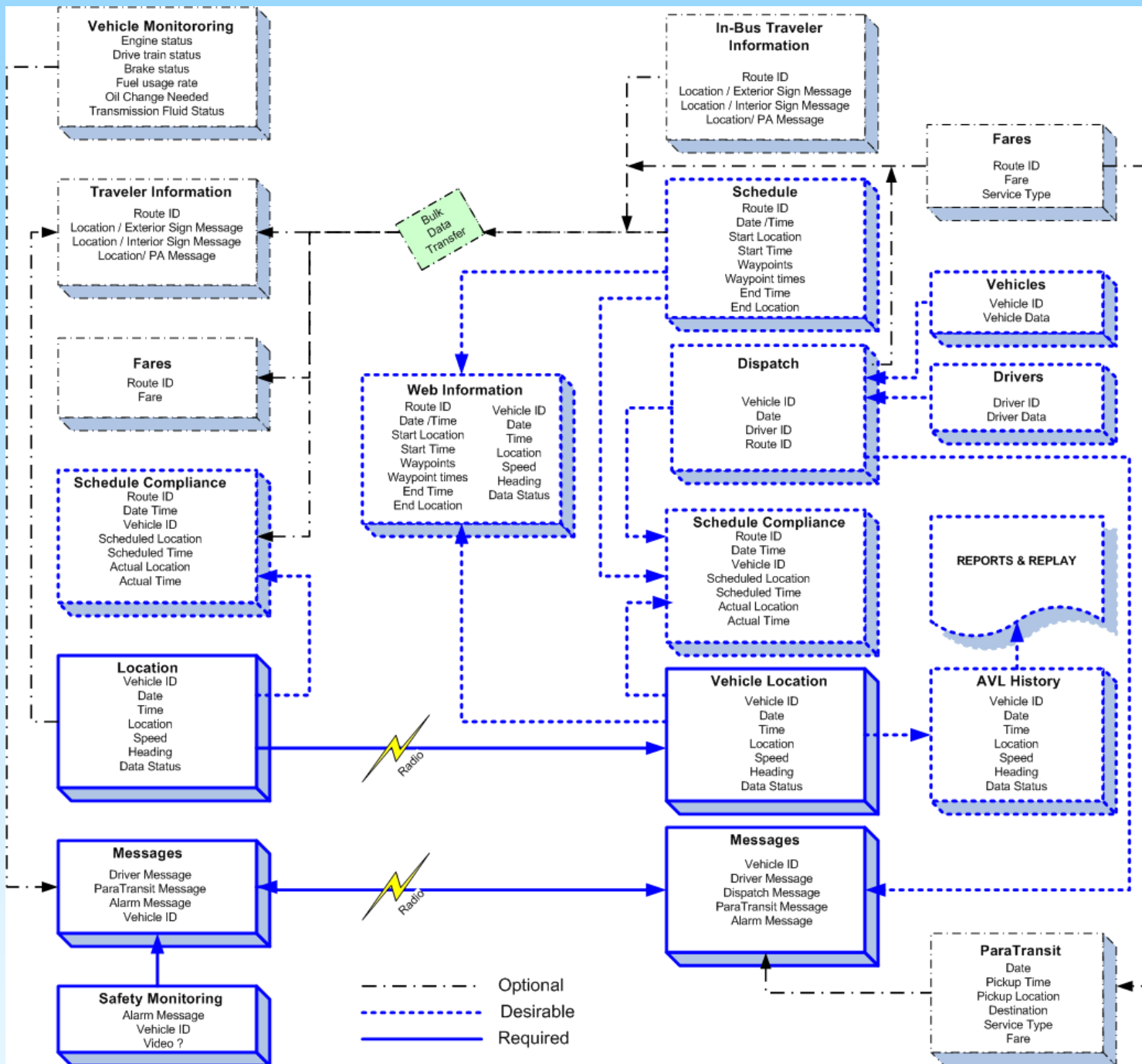
Information Viewpoint

Software View

Provides developers with an overview of the computational objects (software modules), program interactions and behavior, and software interfaces that form the system.

- Helps group functionality into modules for descriptions in the requirements and specifications.
- Helps identify internal and external interfaces that need to be specified.
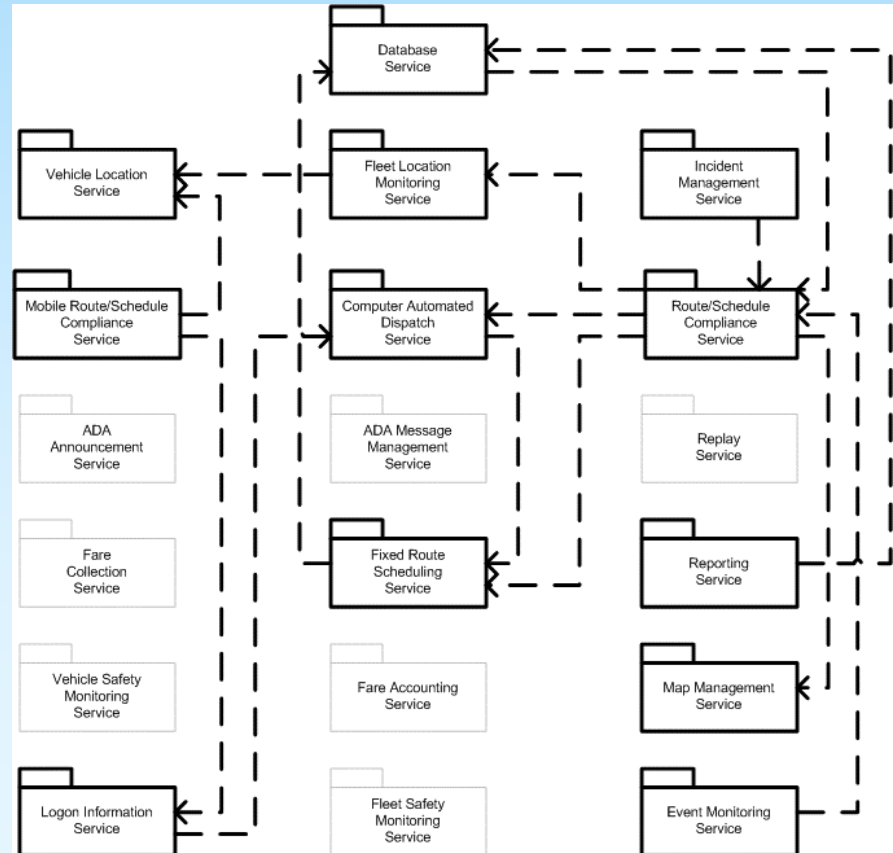- Helps identify critical interaction timing requirements.

When you review…are there any interfaces with other systems we might have missed?

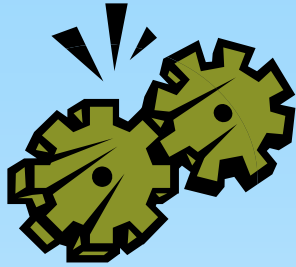# Each function starts with the complete collection of services….

And shows the interfaces and dependencies between the modules required to perform the function.
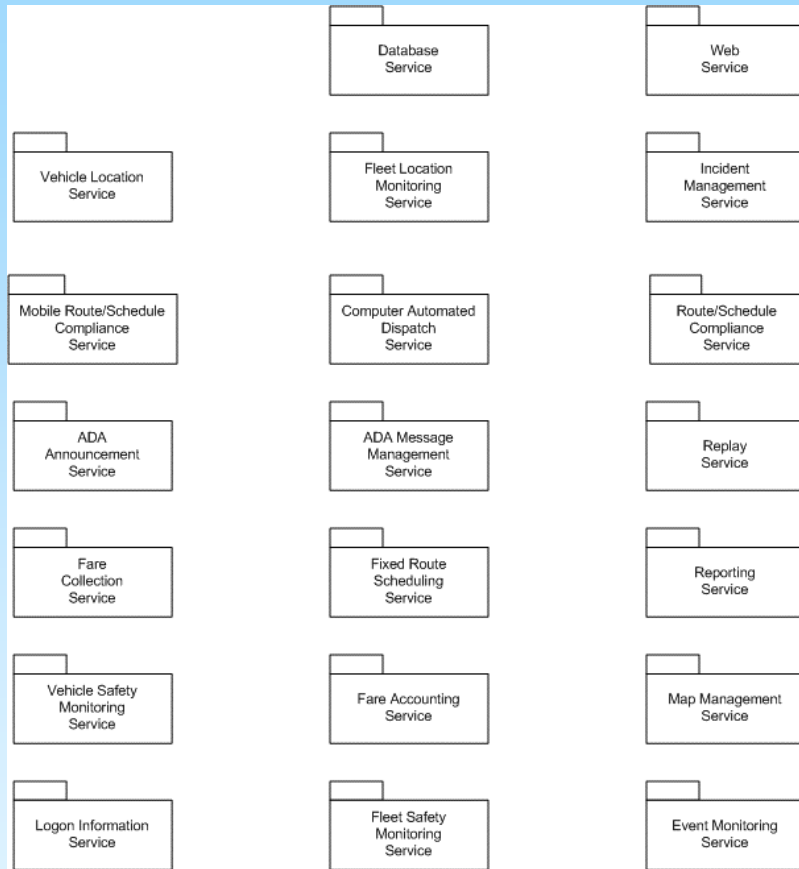
For example, Route/schedule adherence:

Hardware View

Provides the system developers, communication system designers, network system designers, and hardware designers with an overview of the hardware modules, interfaces, and communications support required.

- Identifies potential hardware requirements
- Shows communication paths
- Can show tight versus loose integration
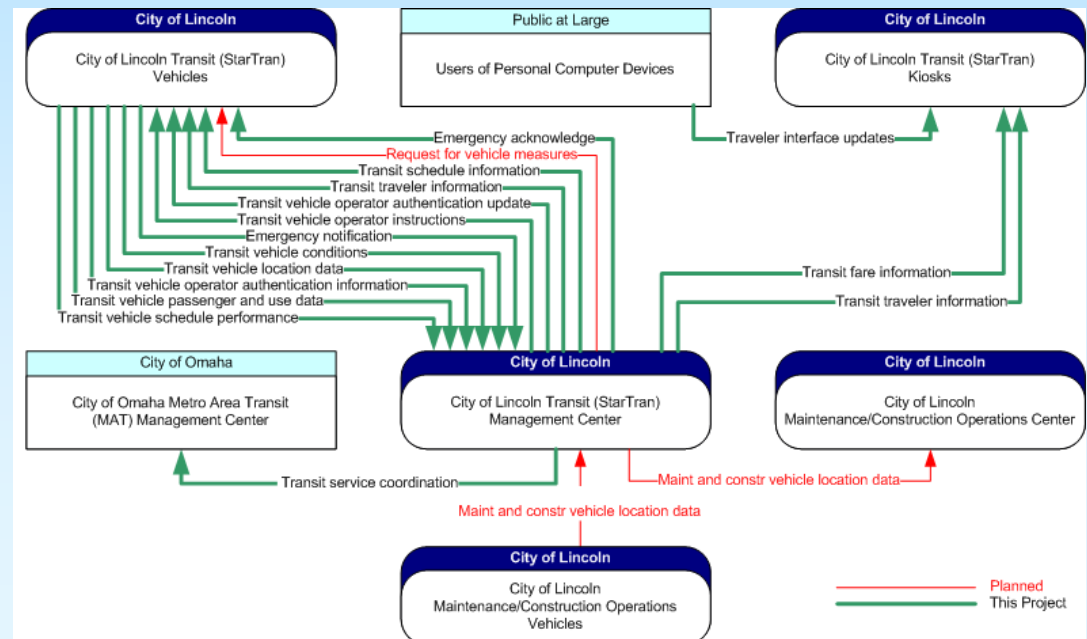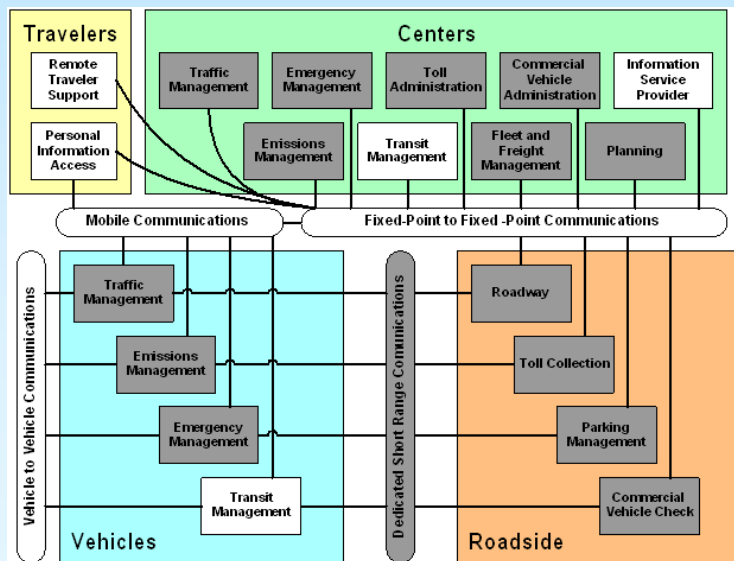- Can show phasing of deployment and/or "nice" vs. essential

Hardware Viewpoint
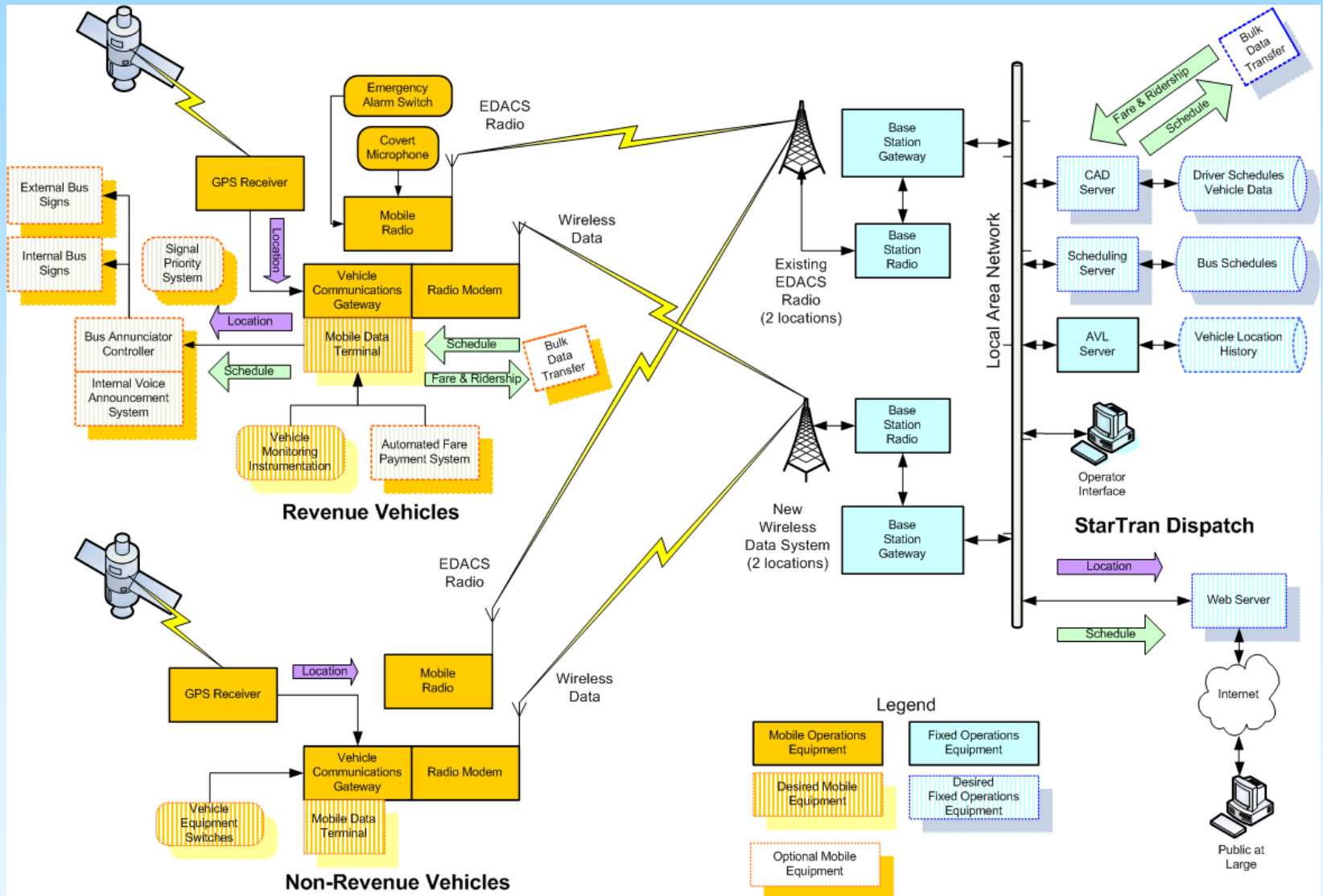
National/Regional Architecture View

These views are usually provided when Federal money is involved. They show how the proposed system fits into the National and Regional ITS architectures, and how the system fits into the defined market packages of the national architecture.

Technology View

Provides an overview of what technologies will be used, and how industry standards and specifications will be implemented.

Where alternative technologies exist, the options can be evaluated in light of the basic system requirements.

Challenges identified so far:

- Where should route/schedule compliance be calculated?
- What is the best bulk data transfer technology?
- Which technology should be used for data communications?
- Priority miss-matches: higher priority functions depending on lower priority functions
- Time and budget vs. a growing list of "needs"

Next Steps

- Decisions We Need to Make
- Information MHI Needs
- Outline of the Requirements to Follow

Feature Prioritization – Functional Requirements

- Vehicle Location and Status
- Information Storage Functions
- Playbacks
- Fleet Data Import and Export
- Silent Emergency Alarms
- Video with Emergency Alarms
- System Event Recording
- Incident Manage
- Fixed Route Scheduling Functions
- Paratransit Scheduling Functions
- Vehicle Operator Logon/Logoff
- Traffic Signal Priority

- Schedule & Route Adherence Monitoring at Dispatch
- Route/Schedule Adherence Status in the Bus
- Data/Text Messaging
- Manifest Display & Management Functions
- On-Board Next Stop Audio & Visual Announcements
- Mechanical Alarms
- Automated Fare Collection
- Automated Passenger Counting
- Web Interface
- Bulk Data Transfer

Feature Prioritization – Data Management & Reporting

- Report Production Functions
- Event Reports
- Incident Reports
- Schedule & Route Adherence Reports
- Pull-in/Pull-out Reports
- FTA Reports
- Automatic Passenger Counting Reports
- Data Retention Periods
- Data Archival Functions

# Feature Prioritization – Hardware Requirements

- Base Station Radios & Gateway
- Differential GPS Reference Receiver
- Vehicle EDACS Radio Transceivers
- Mobile Radios (Data)
- Mobile Data Terminals
- Vehicle Area Network Interface
- Automated Next Stop Announcement & Display System
- Service Supervisor Laptop Computers
- Bas Wireless LAN

Safety Monitoring

The emergency alarm switch and covert microphone are typically integrated into the Mobile Data Terminal. If we use separate EDACS and data radios, this may not be possible. If EDACS does not currently support the emergency alarms, adding the equipment will not solve the problem.

Enabling real-time digital video dramatically affects the bandwidth needed to send the video to the dispatch center.
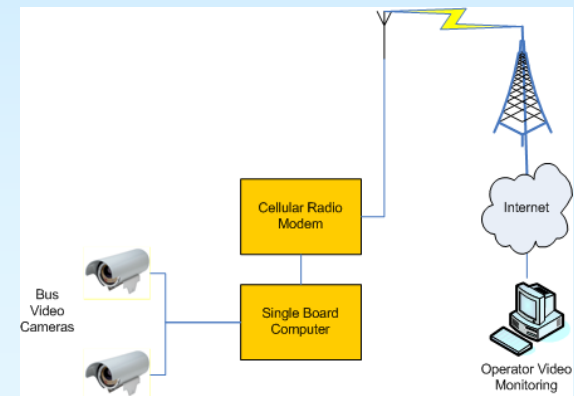
Route/Schedule Adherence

Route/Schedule Adherence monitoring is dependent on an electronic route and schedule to measure against. This implies an existing scheduling system to export the data, or purchasing some scheduling capability.

Sending adherence messages back to each bus on a regular basis will consume valuable bandwidth. We have recommended calculating adherence on the bus and at the dispatch center. This will require transferring each bus's schedule to the bus at the beginning of each run.

The above will make Route/Schedule Adherence dependent on bulk data transfer and an intelligent (programmable) Mobile Data Terminal.

Bulk Data Transfer

Bulk data transfer is listed as "nice to have", but it may be a basic requirement for Route/Schedule Adherence, if we have the compliance calculated on the bus.

Bulk data transfer becomes mandatory if we proceed with ADA compliant announcements and displays on the buses, but the "driver card" systems usually hold about 5K of data, not enough for most of the ADA systems.

If we use Wi-Fi for bulk data, how many terminal locations will we need to cover to make sure all buses are updated at the beginning of each run? Are new runs always started at the bus terminal?

Data Communications

One conventional channel may not be enough.

We have examined five alternatives in the architecture document. None are perfect fits for the application. We have spent about 2 man-weeks on this problem.

- Conventional radio with analog modems will have good coverage, but barely enough bandwidth for AVL and text messaging.

- Digital radios will have double the bandwidth, but we loose coverage.

- Spread-spectrum radios have plenty of bandwidth, but will require 6-8 base station locations throughout town for coverage.

- Wi-fi mesh network also has plenty of bandwidth, but would require hundreds of access points throughout town for even "key location" converge.

- WiMAX has all the advantages of spread-spectrum with the coverage of conventional. Too bad it won't be available for 2 more years.

- Cellular data services also solve the bandwidth and coverage problem, but could result in a $50K per year operating cost.

Automated Fare Collection

Are we going to specify an interface to a future automated fare collection system, or are we specifying the automated fare collection system as an optional feature?

If we specify, who will install the equipment on the buses and at the terminals?

Is the additional funding you have identified going to be added to the procurement?

Statistical Reporting

We need samples of the reports for the requirements specifications. We also need to address where the information for the reports will come from *on a data element by data element* basis.

- What data is collected automatically?

- What data will be manually entered?

- Should the system generate a complete report, or report the data it has?

For example: If these reports cover ridership, how will the passenger counts be acquired and how will the counts get into the database? Do you have passenger counting equipment on the buses?

Vehicle Condition Monitoring

The Concept of Operations lists this as a desirable function, but we have several comments that it is "of no interest" to maintenance or operations.

"Real-time" monitoring from dispatch will require substantially more bandwidth than is currently likely to be available.

Mobile Data Equipment for Non-Revenue Vehicles

Based on the current requirements, supervisory vehicles will not be equipped with route adherence information.

Is text messaging necessary in non-revenue vehicles?

Are new EDACS radios needed in non-revenue vehicles?

Trip Planning

Trip planning can either be an expensive software development exercise, or it could be "free".

Google is working on a transit trip planner, which might provide StarTran with a free trip planner, if we can generate the StarTran route and schedule data in a format that Google Transit can use.